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**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Paper No. 14

Application Number: 09/444,689
Filing Date: November 22, 1999
Appellant(s): MOGHADDAM ET AL.

Alfred A. Stadnicki
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 28 July 2003.

(1) Real Party in Interest

A statement identifying the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

A statement identifying the related appeals and interferences which will directly affect or be directly affected by or have a bearing on the decision in the pending appeal is contained in the brief.

(3) Status of Claims

The statement of the status of the claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Invention

The summary of invention contained in the brief is correct.

(6) Issues

The appellant's statement of the issues in the brief is substantially correct. The changes are as follows:

In Paper 7, claims 1-12 were mistakenly rejected under 35 U.S.C. 103 as being unpatentable over Osuna and Gutta (paragraph 6). It should have read: claims 1 and 4-12 are rejected under 35 U.S.C. 103 as being unpatentable over Osuna and Gutta --. [Claims 2 and 3 are rejected under 35 U.S.C. 103 as being unpatentable over Osuna and Gutta as applied to claim 1, and further in view of Moghaddam (paragraph 7).]

(7) Grouping of Claims

Appellant's brief includes a statement that claims 1, 3, and 6 do not stand or fall together and provides reasons as set forth in 37 CFR 1.192(c)(7) and (c)(8).

(8) Claims Appealed

The copy of the appealed claims contained in the Appendix to the brief is correct.

(9) Prior Art of Record

Osuna et al. "Training Support Vector Machines: An application to Face Detection" IEEE Computer Society Conference on Computer Vision and Pattern recognition, (June, 1997), pp. 130-136.

Gutta et al. "Gender Classification of Human Faces Using Hybrid Classifier Systems" IEEE International Conference on Neural Netweorks, vol 3, (June, 1997), pp. 1353-1358.

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(10) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim 1, 4-8, and 10-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Osuna and Gutta.

Regarding claim 1, Osuna discloses a method for classifying objects in images as face or non-face, comprising the steps of:

supplying a vector support machine with a plurality of training images, including images of faces (page 134, column 1, section 3.2: a database of face and non-face images is used to train an SVM);

determining a plurality of support vectors from the training images for identifying a hyperplane (page 130-131, section 1.1: support vectors are extracted from a data set of labeled examples; "the support vectors are the data points that lie at the border [of the hyperplane] between the two classes" (page 131, first paragraph));

supplying the support vector machine with a test image (page 134-135, section 3.2.1: system is tested using two sets of images);

classifying the test image with respect to the hyperplane (page 134, column 2, under "4.": "classify the pattern using the SVM" and Table 2, page 135).

Osuna is silent to using his SVM classification system for classifying faces by gender.

Gutta discloses a hybrid classifier system that classifies images of faces based on gender using trained learning systems. Gutta's system performs similar to that of Osuna: a training set is used to train the system, and then test images are applied and classified.

It would have been obvious to one of ordinary skill in the art at the time of the invention to employ Osuna's system for classifying images of faces according to gender, since determining the gender of a person is one of the basic identifying features of a person, and Gutta teaches that a trainable learning system can be used to classify face images by gender. In addition, Osuna suggests that his classification system can be utilized to classify any "object classes in the real world that share similar characteristics."

Regarding claim 4, Osuna is silent to reducing the resolution of the training images and the test image by sub-sampling before supplying the images to the support vector machine.

Gutta discloses normalizing training and test images by reducing the resolution before supplying the images to a training system (page 1356, section 5, first paragraph: images at 256 x

384 are reduced to 64 x 72. Pages 1356-1357, section 5, second paragraph: 2000 images are divided into two sets -- 1900 and 100; then 100 of the 1900 are used for training, and the 1800 others are used for testing). Gutta is silent to reducing the resolution by sub-sampling, however using sub-sampling to reduce the resolution of an image was conventional and well-known to those of ordinary skill in the art at the time the invention was made. Official notice taken.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Osuna by Gutta in order to reduce the size of testing and training images, since doing so reduces memory requirements and reduces training time.

Regarding claim 5, Osuna discloses maximizing a distance between the support vectors and error margins of the hyperplane (page 130, section 1.1, second paragraph: "Intuitively, a good choice is the hyperplane that leaves the maximum margin between the two classes," and also figure 1).

Regarding claim 6, Osuna discloses using test images that are 19 x 19 = 361 pixels (section 3.2, page 134). These 19 x 19 test images are substantially close to Applicant's disclosed low resolution "thumbnail" images, which are 21 x 12 = 252 pixels, in contrast to the disclosed high resolution images, which are 80 x 40 = 3,200 pixels (page 11, specification). The exact sizes and dimensions of the test images are considered to be arbitrary design parameters since no unexpected results are produced by using a 21 x 12 test image as opposed to a 19 x 19 test image.

Regarding claim 7, Osuna discloses forming a non-linear hyperplane (figure 6 and page 131, column 1: "Since it is unlikely that any real life problem can actually be solved by a linear classifier, the technique has to be extended in order to allow for non-linear decision surfaces").

Regarding claim 8, Osuna discloses having a 2.9% classification error for a test run (table 2, page 135).

Regarding claim 10, Osuna discloses determining the non-linear hyperplane using a non-linear projection function (page 131, column 1: "projecting the original set of variables x in a higher dimensional feature space ... the solution will have the form *[non-linear projection function]*, and therefore will be non-linear").

Regarding claim 11, Osuna discloses a Gaussian RBF as a projection function (page 131, column 1). The function takes the form $K(x,x_i) = \exp(-\|x - x_i\|^2)$, which is employed to minimize the expected test error between x and x_i.

Regarding claim 12, Osuna discloses using a quadratic classifier (table 1, page 131: classifier $K(x,x_i) = (x^T x_i + 1)^d$, which is quadratic for d = 2.

Claims 2 and 3 are rejected under 35 U.S.C. 103(a) as being unpatentable over Osuna and Gutta as applied to claim 1, and further in view of Moghaddam.

Regarding claim 2, Gutta discloses passing training images to a face detection and normalization system that detects faces and scales the images to a reduced resolution (page 1356, section 5, first paragraph). However, the scaling is not performed in order to locate the faces.

Also, Gutta and Osuna are silent to warping scaled images to locate facial features.

Moghaddam discloses a method for recognizing faces and facial features in images. Moghaddam discloses scaling an input image to a number of levels (column 10, lines 41-44), and from the scaled images, finding a window that has the highest probability of containing a face (column 11, lines 1-4). Moghaddam then discloses warping the detected face to be spatially

aligned with that of the training set so that features of the face may be easily recognized (column 11, lines 10-14).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Osuna and Gutta by Moghaddam in order to achieve the claimed invention, since preprocessing of the training images by scaling and warping effects normalization of the training images, which facilitates the training process by placing all input images in a similar format. [See also figure 1 of "SexNet" by Golomb et al. wherein images are preprocessed by scaling and warping in order to align and normalize the faces so that features may be easy to locate.]

Regarding claim 3, Osuna and Gutta are silent to masking the scaled images to reduce the amount of hair.

Moghaddam discloses masking the scaled image to "include only an interior of the face" so that only "the most salient facial components" are present (column 11, lines 15-18).

It would have been obvious to one of ordinary skill in the art at the time of the invention to further modify Osuna and Gutta by Moghaddam to mask the scaled images to reduce the amount of hair by including only the interior of the face, since hair (on the head) is not a facial feature and is therefore immaterial to determining the gender of a face.

(11) Response to Argument

With regards to claim 1, Osuna discloses a trainable object recognition system that utilizes support vector machines (SVMs). Osuna's SVM is defined as a "pattern classification algorithm" (see section "1 Intoduction") that essentially functions to recognize objects and classify them accordingly.

Appellant has argued the notion of "detection" vs. "classification" and how the two categories/processes substantially differ. Allegedly, Osuna performs "detection", while the present invention performs "classification". However, on numerous occasions, Osuna refers to his SVMs as "classifiers" or as performing "classification". It is true that Osuna's system <u>detects</u> faces. But it can also be said that Osuna's system <u>classifies</u> objects as faces. The common denominator here is that both Osuna's SVMs and the present invention's SVMs are utilized for recognizing objects or patterns and classifying them accordingly.

Osuna's paper employs the example of classifying objects as "face" or "non-face" since "face detection is interesting because it is an example of a natural and challenging problem". However, as has been previously cited, Osuna suggests that his SVMs are applicable for detecting/recognizing/classifying a wide range of "object classes and phenomena in the real world that share similar characteristics" (see section "3 SVM Application: Face Detection"). Furthermore, according to Osuna, "a successful and general methodology for finding faces using SVM's should generalize well for other spatially well-defined pattern and feature detection problems". The suggestion to utilize Osuna's SVMs for "other object classes" is clear.

Gutta discloses a system that classifies human faces according to gender. Gutta's system is comprised of a radial basis function (RBF) classifier and inductive decision trees (see "3.

Hybrid Classifier Architecture" and figure 1). To summarize sections 3.1, 3.1.1, and 3.1.2, the RBF classifier is a trainable network, "very similar to that of a traditional three-layer back-propagation network" (i.e. a neural network).

A neural network is essentially a trainable mathematical model. In its most simple operation, a set of inputs, call "training data", are applied to the network. The network is then trained to "learn" the training data. The training data is applied to the system (forward propagation), and a result is computed. The difference between the actual result and the desired result (i.e. the error) is run backwards through the network (back propagation). As the error is back-propagated, the parameters of the network are adjusted so that the mean-squared error (or other similar metric) is reduced. The training data is repeatedly applied and the parameters (i.e. "weights") of the system are repeatedly adjusted until the network is sufficiently optimized. The premise is that once the network is trained to learn the training data, it will generalize well for other input data it hasn't been trained to learn. Gutta system's is trained to classify faces as either male or female. A set of x male and female faces are used as training data. Once the system is "trained", a non-training face is input to the system, and the system should recognize it as male or female.

A complete understanding of RBF classifiers and neural networks is not important. The main idea is that Gutta's RBF classifier is a trainable network used to classify objects into distinct classes. In Gutta's paper, the "objects" are human faces, and the "classes" are male and female.

Gutta was relied upon to cure the deficiencies of Osuna. Namely, to provide the suggestion to utilize Osuna's system for gender classification. There is not a reasonable

expectation of success that Osuna's system is able to classify faces by gender; there is an almost *definite* expectation of success. In Osuna's abstract and section "1 Intoduction", Osuna discloses that SVMs "can be seen as a new method for training polynomial, neural network, or Radial Basis Function classifiers" (emphasis added). SVMs can be thought to incorporate an RBF classifier, since SVMs, as Osuna discloses, comprise a new method for training RBF classifiers.

Since Osuna discloses that SVMs generalize well for other object recognition problems, and since SVMs are compatible with RBF classifiers (which are employed by Gutta in gender classification), one skilled in the art would have found it obvious that Osuna's system is operable to classify faces by gender, as claimed.

The converse is also obvious: Gutta in view of Osuna. It would have been obvious to utilize SVMs to train Gutta's RBF classifier since Osuna teaches that SVMs are a new method for training RBF classifiers.

Regarding claim 3, Applicant argues that the combination of Osuna, Gutta, and Moghaddam is improper because "Moghaddam, like Osuna, is directed to objection detection, not object classification" (page 9).

Response: The alleged distinction between classifying and detecting is addressed above.

Further regarding claim 3, Appellant argues that there is no teaching or suggestion that scalp hair should or could beneficially be removed in gender classification (pages 10 and 12).

Response: Moghaddam, like Osuna and Gutta, utilizes a trainable system to recognize/classify/detect objects, or more particularly, faces. Column 5, lines 7-20. Moghaddam teaches masking the face (i.e. reducing the hair) so that only the interior of the face is utilized

and the most salient facial features are applied (column 11, lines 15-18). This face normalization process is akin to that Gutta, as shown in figure 1 (of Gutta). In both systems, the faces are normalized in some manner before being input to the classifier. The face normalizations ensure that the training images are consistent and are placed in the most desirable form or format for training. Moghaddam teaches that masking to reduce hair allows the classifier to concentrate on only the most prominent facial features and effectively eliminates non-facial features (such as hair).

Regarding claim 6, neither Osuna nor Gutta disclose that the test image is less than 260 pixels. However, it is the Examiner's view that this feature alone is not a patentable distinction. Other than the well-known advantages of using smaller images (i.e. faster computation, less memory requirement, etc.), the Specification does not disclose any unexpected or previously unappreciated results due to using a test image that is specifically less than 260 pixels. For this reason, it is believed that the exact size and dimensions of a test image are parameters that depend entirely upon the operating environment and there exists no unusually advantageous benefits to using a test image that is a certain size or within a certain range.

Appellant argues Examiner has not established a prima facie case (page 6). Response: a prima facie case has been established in the Final Rejection (paper 7). Additional evidence and rationale in support of said case is found herein.

Appellant has argued "hindsight" (pages 6 and 17). Response: Osuna's suggestion for using his system for other classification problems is clear.

Appellant argues that Gutta and the present invention "go about accomplishing this objective [gender classification] in substantially different ways" (page 8). Response: As established above, SVMs of Osuna and the present invention and Gutta's RBF classifiers are very closely related.

Appellant argues that "Gutta teaches the use of a decision tree for classifying male/female faces, whereas the present application teaches the use of a SVM for classifying male/female face". Response: It appears Gutta's decision trees merely interpret the results of classification rather than perform the classification. See section "3 Hybrid Classifier Architecture": "using the RBF outputs, the decision trees (DT) implement the symbolic stage, because they provide for flexible and adaptive thresholds, and they can **interpret ('explain')** the way classification and retrieval are eventually achieved" (emphasis added). Thus, the RBF classifier presumably performs the actual classification. Regardless of this fact, Gutta's decision trees are used in conjunction with RBF classifiers, which are improved through the use of SVMs, as taught by Osuna.

Appellant has argued "there is no motivation to combine the art" (page 10) and "the applied references fail to suggest the claimed invention" (page 13). Response: Osuna teaches that his trainable system generalizes well for other intended uses, and Gutta shows that trainable systems (esp. those utilizing RBF classifiers) are operable to solve the previously recognized problem of gender classification.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

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August 21, 2003

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